

Manis crassicaudata. By Martha E. Heath

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Manis crassicaudata Gray, 1827

Indian pangolin

Manis crassicaudata Gray, 1827:282. Type locality India. *Pholidotus indicus* Gray, 1865:368.

CONTEXT AND CONTENT. Order Pholidota (Weber, 1904), Family Manidae (Gray, 1821), genus *Manis* (Linnaeus, 1758). This genus contains seven extant species: *M. crassicaudata*, *M. gigantea*, *M. longicaudata* (=*tetradactyla*), *M. javanica*, *M. pentadactyla*, *M. temminckii*, and *M. tricuspidis*. Generic context and content, and a key to species is presented in Heath (1992a). *M. crassicaudata* is monotypic. This species has been called *M. pentadactyla* in error (Ellerman and Morrison-Scott 1951; Emry, 1970).

DIAGNOSIS. The distributions of *M. crassicaudata* and *M. pentadactyla* overlap in northern India (Roberts and Vielliard, 1971). There are several overt characteristics that differentiate these species. *M. crassicaudata* has larger scales and smaller ear pinnae than *M. pentadactyla* (Pocock, 1924). *M. crassicaudata* has 11–13 rows of body scales compared to 15–18 rows in *M. pentadactyla* (Pocock, 1924). A terminal scale is present on the ventral side of the tail in *M. crassicaudata*, but absent in *M. pentadactyla* (Ogilvie and Bridgwater, 1967; Pocock, 1924). *M. pentadactyla* has a post-anal depression in the skin, and a distinct narrowing of the tail toward the end; both characteristics are absent in *M. crassicaudata* (Pocock, 1924).

GENERAL CHARACTERS. *Manis crassicaudata* is a medium-sized mammal, with a streamline elongated body and tail covered with large overlapping scales rather than fur (Fig. 1). Because of its exclusive myrmecophagous diet, it has many anatomical adaptations associated for procuring and eating ants and termites (reviewed by Heath 1992a, 1992b).

The head (Fig. 2) is small and cone shaped, with small eyes protected by thick eyelids. *M. crassicaudata* has well-defined, but small, ear pinnae. The tail is long, thick, rounded on the dorsal surface and flat on the ventral surface, muscular, and prehensile. The forelegs are powerful and have robust claws. The three central front claws are enlarged and elongated and are used for tearing apart ant and termite nests, and for digging burrows. The hind legs are short and stout and have short claws. All limbs have five clawed digits. The forefeet are carried with the long claws curled under, with the knuckles touching the ground only periodically for balance. Indian pangolins are agile climbers. There is a pad of sensory tissue at the end of the tail. *Manis crassicaudata* has anal glands containing an "evil smelling" yellowish fluid that is used as defense (Hutton, 1949:805).

Prater (1980) reports length of head and body as 60–75 cm, and length of tail as 44.5 cm. A female weighing 4.7 kg had a tail-tip to vent length of 38 cm and a total length of 89 cm (Aiyappan, 1942). The tongue was 30.5 cm, and forelegs and hind legs were 9 and 10 cm long, respectively. Tail girth at the base was 30.5 cm. There were 46 scales from the tip of the tail to the forehead and 16 scales along the length of the tail. The largest of the yellow-gray colored scales was 7 cm long and 5 cm wide. A 3.9-kg female was 86.5 cm in total length and 33 cm from vent to tip of tail. The tongue was 23–25.5 cm in length (Aiyappan, 1942).

DISTRIBUTION. *Manis crassicaudata* occurs throughout peninsular India (Israel et al., 1987; Prater, 1980). Its range extends as far west as Pakistan, east to West Bengal (India) and Yunnan (southwest China), south to Sri Lanka and, north to Nepal (Fig. 3; Roberts and Vielliard, 1971; Schlitter, 1993). It inhabits plains and lower slopes (Prater, 1980), although one female was found at 2300 m elevation in Nilgiris, India (Hutton, 1949). *M. crassicaudata* once occurred in Bangladesh, but is now extirpated. There is no

fossil record for *M. crassicaudata*, although fossil pholidotes have been found in Asia, Africa, Europe, and North America (Heath, 1992b).

FORM AND FUNCTION. The scales covering *Manis crassicaudata* are made of fused hair, originate from a thick skin, and continue to grow from the base throughout life. This compensates for wear at the outer edge. They are yellow-brown or yellow-gray in color (Aiyappan, 1942). Scales cover all surfaces except the foot pads, ventral side of the head and trunk, and inner surface of the limbs. Those surfaces not covered by scales are sparsely populated with white or gray hairs. Scale size, shape, and ridge pattern are species-specific characteristics (Kuehn, 1986). Jentink (1882) reported considerable intra- and interspecific variation in the number and pattern of scales on the tail, head, or trunk region.

Manis crassicaudata has 15–18 rows of scales on the trunk (Prater, 1980) that are arranged from the dorsal mid-line outward (Jentink, 1882). Rows of scales on the forelegs are horizontal and on the hind legs are vertical with respect to the ground. Along the side of the tail are 14–16 scales that are folded along their mid-line and define the edge of the tail. These scales are pointed and sharp and can inflict injury to anything trying to grasp the tail (Pocock, 1924).

The skin and scales of ground pangolins make up $\frac{1}{4}$ to $\frac{1}{3}$ of their total body mass (Kingdon, 1974) and thus represent a large investment. The scales provide little insulation or protection from external parasites. However, they require no grooming, deter predators, and protect the skin against scratches from underbrush or sharp rocks along burrow walls. As a defense the Indian pangolin rolls into a tight sphere presenting only its scales to a predator.

Manis crassicaudata is toothless. Maceration of all food occurs in the stomach, which has two chambers (Grasse, 1955). The first compartment makes up about $\frac{1}{3}$ of total size, is thin walled, and functions as a storage chamber. At the bottom of the first chamber is a gland that secretes fluid (not described). The second smaller chamber has thick muscular walls with many rugae on the inner surface. Near the upper part of the pylorus is a rough, hard, spherical tissue mass that grinds or macerates food before it passes through the pylorus to the intestine (Grasse, 1955).

The number of vertebrae differs for each species of pangolin, ranging from 48 in *M. temminckii* to more than 70 in *M. longicaudata* (Jentink, 1882). *M. crassicaudata* has 7 C, 15 T, 6 L, 3 S and 26 Ca, total 57 vertebrae (Jentink, 1882). Lumbar vertebrae



FIG. 1. Adult *Manis crassicaudata*.

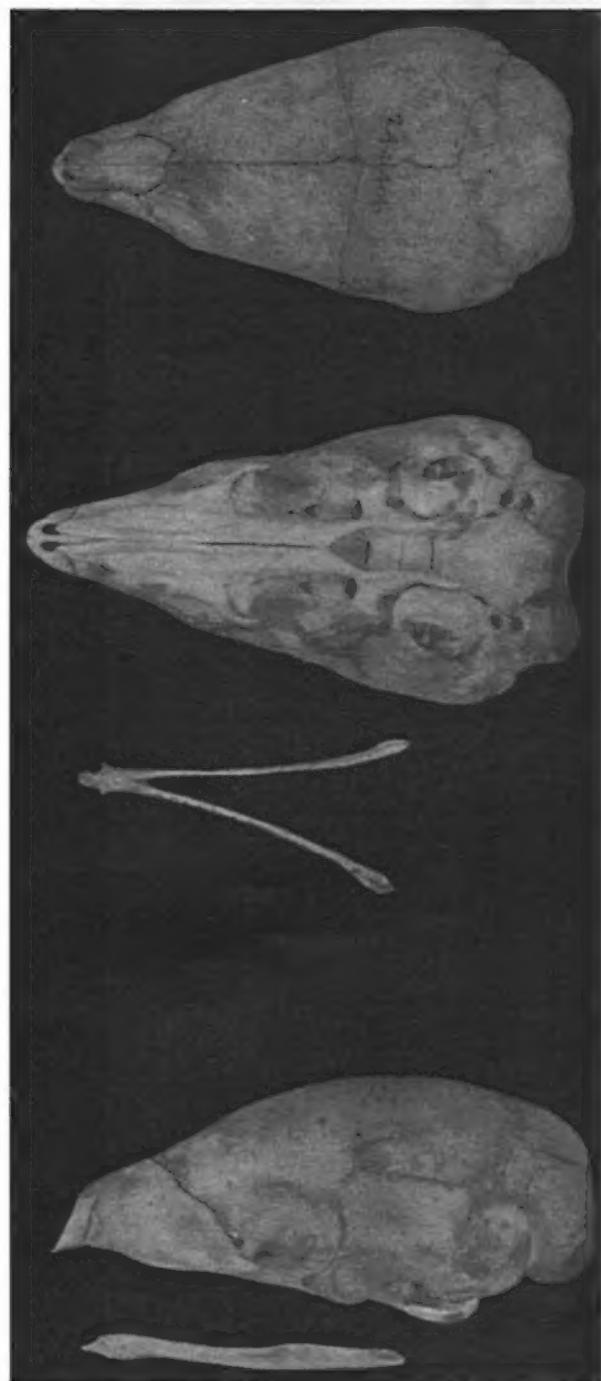


FIG. 2. Dorsal, ventral and lateral views of the cranium and lateral view of the mandible of a male *Manis crassicaudata* (American Museum of Natural History, New York, 244406, from India). Greatest length of cranium is 77.5 mm.

have well developed concave zygapophyses anteriorly, but supplementary articular processes.

The skull and mandible of *Manis crassicaudata* are shown in Fig. 2. The anatomy of the pangolin skull is reviewed in Heath (1992a) and its development is described by Parker (1885). There is no detailed comparison of skulls from extant species of pangolins, but Emry (1970) compares the skull and skeletal features of *Patriomanis*, an extinct pangolin genus, and extant *Manis* species.

Manis crassicaudata does not show pronounced cerebralization. From a lateral view, the brain has a simple serial configuration of its three major components, with the cerebral hemispheres not overlapping either the olfactory bulbs or the cerebellum (Grasse, 1955; Kowalski, 1971). The olfactory lobes are short, level with the cerebral hemispheres, and without neural fibers entering dorsally.

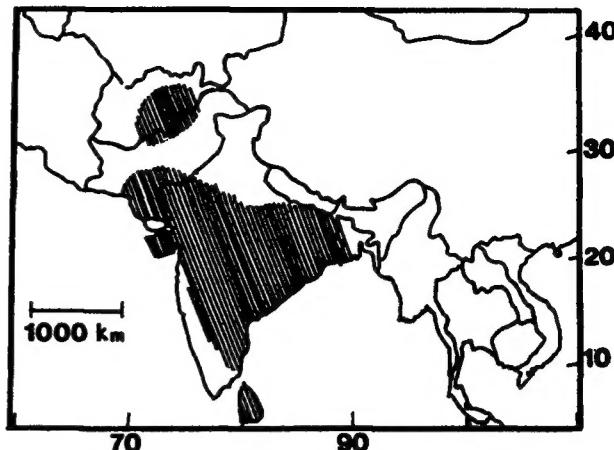


FIG. 3. Present distribution of *Manis crassicaudata* is represented by the hatched area.

The cerebellum is relatively large and well-differentiated, with the vermis and lateral lobes of the cerebellum being of similar size. A bony projection of the skull protrudes between the cerebrum and cerebellum (Grasse, 1955; Kowalski, 1971).

Females have two small pectoral mammae (5–8 mm), which are dark at the tip. (Aiyappan, 1942). There is a slight genital eminence in females. The vulva consists of a slit flanked by a ridge of tissue that is puckered. The anal orifice is immediately posterior to the genital eminence. The uterus is bicornuate and the placenta is diffuse and nondeciduate (Grasse, 1955; Kowalski, 1971). In males, the penis is well developed. The testes do not descend into a scrotum, but pass through the inguinal canal at sexual maturity and enlarge in a fold of skin in the groin (Kuehn, 1986).

Mean core temperature (33.4°C) and metabolic rate ($0.078 \pm 0.007 \text{ cm}^3 \text{ O}_2 \text{ g}^{-1} \text{ h}^{-1}$) were measured in one 16 kg *Manis crassicaudata* (McNab, 1988). This metabolic rate is only 36% of the expected value calculated from the all-mammal equation (McNab, 1988), but is similar to metabolic rates observed in other pangolin species, as well as other ant and termite eaters (Heath and Hammel, 1986). This is due in part to an unusually large portion of total mass ($\frac{1}{4}$ to $\frac{1}{3}$) being scales, which are metabolically inactive.

ONTOGENY AND REPRODUCTION. Usually a single young is produced (Israel et al., 1987), but occasionally two are born (Prater, 1980). Births have been reported in January (Ogilvie and Bridgwater, 1967), July (Prater, 1980) and November (Asdell, 1964). A 10.6 kg female gave birth at the Nandankanan Zoo (Orissa, India) to an offspring that weighed 235 g and measured 30 cm in total length, including a 12.5-cm long tail (Acharjyo and Misra, 1972). The newborn had its eyes open, its scales were soft, and there were gray hairs between the scales. It crawled immediately. Another captive female gave birth to a 400-g young (Blandford, 1916). Two adults of both sexes were found in the same burrow with one young (Prater, 1980).

Young are carried on the dorsal base of the mother's tail (Israel et al., 1987; Phillips, 1928). When disturbed, a female with young will coil into a sphere around its offspring. The offspring is protected at the center of the sphere next to the ventral surface of the female (Phillips, 1928).

ECOLOGY. Populations of Asian pangolin species, including *Manis crassicaudata*, are thought to have decreased significantly in many areas due to hunting and trade (Broad et al., 1988). However, little is known about the status of the Indian pangolin throughout much of its range (Burton and Pearson, 1987). It is estimated that more than 185,000 pangolins skins were legally exported from Asia from 1980 to 1985, with 90% going to the United States (Broad et al., 1988; Nowak, 1991). Indian pangolins are hunted for their flesh, skin, and scales (Nowak, 1991). The scales are thought to have medicinal and magical powers (Israel et al., 1987) and are made into rings or charms (Prater, 1980); skins are used to manufacture boots and shoes (Broad et al., 1988). *M. crassicaudata* is listed in Appendix II of the Convention on International Trade in Endangered Species (CITES).

Manis crassicaudata eats eggs, young, and adults of ant and termites (Prater, 1980), but is selective in terms of prey species. A

semi-captive pangolin would not eat ants and termites found under logs and stones, but did burrow into termite mounds. Phillips (1928) reported that a captive individual readily ate black ants, but ignored small red ants and white ants (termites). Eggs were preferred over adult ants. The most favored food sources were leaf-nests that contained many eggs as well as some adult large red ants. An Indian pangolin from Nilgiris, India had black ants, beetle wing sheaths, remains of cockroaches, and what appeared to be skins of worms and grubs in its stomach (Hutton, 1949), indicating that *M. crassicaudata* is not necessarily strictly myrmecophagous. Pangolins drink when water is available, however, pangolins living in deserts exist without water for long periods (Prater, 1980).

Manis crassicaudata is active at night and spends the day in a burrow or among rocks (Prater, 1980). Burrow depth varies with soil type, ranging from 2 m in rocky soil to 6 m in loose soil (Prater, 1980). When inside the burrow, Indian pangolins close the entrance with soil.

The longevity of *M. crassicaudata* in captivity is >13.5 years (Jones, 1977). Longevity in the wild is unknown.

Single instances of toxoplasmosis (*Toxoplasma gondii*) and an intestinal fluke (*Echinostoma malayanum*) have been reported in *M. crassicaudatus* (Kageruka and Willaert, 1971; Pande, 1979). Hutton (1949) reported an individual from Nilgiris, India with a heavy infestation of ticks of several kinds (species unidentified).

Indian pangolins in Sri Lanka live in the rain forest canopy where flowers and fruit that attract ants occur, instead of at ground level where it is very dark with limited food supply (Israel et al., 1987). This indicates that, although *M. crassicaudata* is considered a "ground pangolin," it may become arboreal in certain habitats or under appropriate conditions.

BEHAVIOR. *Manis crassicaudata* walks quadrupedally, with back arched and both trunk and tail parallel to and above the ground (Israel et al., 1987; Prater, 1980). *M. crassicaudata* often stands on its hind legs with head elevated to survey the surroundings (Israel et al., 1987; Prater, 1980). *M. crassicaudata* emits a loud hissing sound when disturbed (Israel et al., 1987).

Manis crassicaudata excavates its own burrows, and digs into ant and termite nests for prey. Soil is loosened with claws of either or both front feet. Digging is interrupted to remove the loose soil by throwing it backwards between the hind legs and then kicking it away with the hind feet (Prater, 1980). The Indian pangolin will also back out of the burrow while carrying or pulling soil with its forefeet. This is probably the only way to remove soil from deep in the burrow.

Indian pangolins are agile climbers and probably climb trees in pursuit of ants. They use their limbs to grip the tree, and their prehensile tail for support while repositioning their forelegs further up the trunk (Prater, 1980).

Indian pangolins have poor vision and hearing, but an excellent sense of smell (Israel et al., 1987). When foraging, the Indian pangolin relies on smell, sniffing the soil constantly while searching for the best place to dig into the ant or termite nest. It continues to sniff the soil while digging, the route of its excavation being guided by scent (Prater, 1980). To feed, pangolins thrust their nose and mouth, or whole head, into an opening in the ant nest, and appear to be lapping up prey in that their throat exhibits the same motion as observed in animals while drinking. When foraging, the Indian pangolin digs up the comb-like fungus gardens that house swarms of adults, young, and eggs (Prater, 1980). Once a comb is found, digging ceases and the prey is licked off and swallowed. Pangolins drink by rapidly moving their tongue in and out of their mouth in a lapping movement (Prater, 1980). Nothing is known concerning the genetics of *M. crassicaudata*.

REMARKS. Common names include Kabalaya in Sinhalese and Alangu in Tamil (Phillips, 1926). Another common name is Arrunkku in Tamil (Stoney, 1945).

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